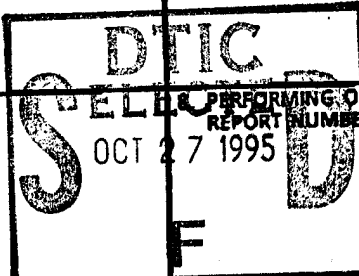


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Andrew J. Majda

FINAL TECHNICAL REPORT  
ARMY CONTRACT DAAL03-92-G-0010  
AT PRINCETON UNIVERSITY  
JANUARY 1, 1992 – JUNE 30, 1995

This report covers the period January 1, 1992 through June 30, 1995, the three year period of this grant. The research performed under this grant includes mathematical analysis of strong fluid mechanical effects at high Mach number in reactive flow. The principal investigator has published the following papers with at least partial support by this research grant:

**Published Papers of A. Majda**

100. (with V. Roytburd), "Low-frequency multidimensional instabilities for reacting shock waves", *Studies in Appl. Math.*, 87, pp. 135-174, 1992
101. (with A. Bourlioux), "Theoretical and numerical structure for unstable two-dimensional detonations", *Combustion and Flame*, 90, pp. 211-229, 1992
102. (with R. Klein and R. McLaughlin), "Asymptotic equations for the stretching of vortex filaments in a background flow field", *Phys. Fluids A* 4, 2271-2281, 1992
103. (with M. Avellaneda), "Superdiffusion in Nearly Stratified Flows", *Journal of Statistical Physics*, 69, pp. 689-729, 1992
104. (with P. Embid and J. Hunter), "Simplified Asymptotic Equations for the Transition to Detonation in Reactive Granular Materials", *SIAM J. Appl. Math.*, 52, pp. 1199-1237, 1992
105. (with R. Klein), "An asymptotic theory for the nonlinear instability of antiparallel pairs of vortex filaments", *Phys. Fluids A*, 6, pp. 369-379, February 1993
106. (with M. Avellaneda), "Application of an approximate R-N-G theory to a model for turbulent transport with exact renormalization", IMA vol. 55, *Turbulence in Fluid Flows: A Dynamical System Approach*, Edited by Foias, Temam, and Sell, pp. 1-32, 1993
107. (with R. McLaughlin), "The effect of mean flows on enhanced diffusivity in transport by incompressible periodic velocity fields", *Studies in Applied Mathematics*, pp. 245-279, 1993
108. (with A. Bourlioux), "High resolution numerical simulations for two-dimensional unstable detonations", *Dynamic Aspects of Detonations*, Progress in Astronautics and Aeronautics, Vol. 153, Edited by A. Kuhl, et al., Washington, DC, pp. 43-63, 1993
109. "The random uniform shear layer: An explicit example of turbulent diffusion with broad tail probability distributions", *Phys. Fluids A*, 5, pp. 1963-1970, August 1993

110. "Explicit inertial range renormalization theory in a model for turbulent diffusion", *Journal of Statistical Physics*, 73, pp. 515-542, 1993
111. "Remarks on weak solutions for vortex sheets with a distinguished sign", *Indiana University Math. Journal*, 43, pp. 921-939, 1993
112. (with P. Constantin and E. Tabak), "Singular front formation in a model for quasi-geostrophic flow", *Letters of Physics of Fluids*, 6, pp. 9-11, January 1994
113. (with M. Avellaneda), "Simple examples with features of renormalization for turbulent transport", *Philos. Trans. Roy. Soc. Ser. A*, 346, pp. 205-233, 1994
114. (with P. Souganidis), "Large scale front dynamics for turbulent reaction diffusion equations with separated velocity scales", *Nonlinearity*, 7, pp. 1-30, 1994
115. (with G. Majda and Y. Zheng), "Concentrations in the one-dimensional Vlasov-Poisson equations, I: temporal development and non-unique weak solutions in the single component case", *Physica D*, 74, pp. 268-300, 1994
116. "Random shearing direction models for isotropic turbulent diffusion", *Journal of Statistical Physics*, 75, pp. 1153-1165, 1994
117. (with F. Elliott), "A wavelet Monte Carlo method for turbulent diffusion with many spatial scales", *Journal of Computational Physics*, 113, pp. 82-111, July 1994
118. (with P. Souganidis), "Large scale front dynamics for turbulent reaction diffusion equations with separated velocity scales", *Nonlinearity*, 7, pp. 1-30, 1994
119. (with G. Majda and Y. Zheng), "Concentrations in the one-dimensional Vlasov-Poisson equations, II: screening and the necessity for measure-valued solutions in the two component case", *Physica D*, 79, pp. 41-76, 1994
120. (with D. Horntrop), "Subtle statistical behavior in simple models for random advection-diffusion", *Journal of Mathematical Sciences, the University of Tokyo*, 1, pp. 23-70, 1994
121. (with P. Constantin and E. Tabak), "Formation of strong fronts in the 2-D quasi-geostrophic thermal active scalar", *Nonlinearity*, 7, pp. 1495-1533, 1994
122. (with Y. Zheng), "Existence of global weak solutions to one-component Vlasov-Poisson and Fokker-Planck-Poisson systems in one space dimension with measures as initial data", *Commun. Pure and Appl. Math.*, 47, pp. 1365-1401, 1994
123. (with F. Elliott), "A new algorithm with plane waves and wavelets for random velocity fields with many spatial scales", *J. Comp. Physics*, 117, pp. 146-162, 1995
124. (with A. Bourlioux), "Theoretical and numerical structure of unstable detonations", *Philos. Trans. Roy. Soc. Ser. A*, 350, pp. 29-68, 1995
125. (with R. Klein and K. Damodaran), "Simplified equations for the interaction of nearly parallel vortex filaments", *Journal of Fluid Mechanics*, 228, pp. 201-248, 1995
126. (with P. Embid and T. Souganidis), "Effective geometric front dynamics for premixed turbulent combustion with separated velocity scales", *Combustion Science and Technology*, 103, pp. 85-115, 1994

### Papers Submitted and/or Accepted by A. Majda

1. (with F. Elliott, Jr., D.J. Horntrop, and R. McLaughlin), "Hierarchical Monte Carlo methods for fractal random fields", submitted to J. Statistical Physics
2. (with P. Embid and P. Souganidis), "Comparison of turbulent flame speeds from complete averaging and the G-equation",
3. (with P. Constantin and C. Fefferman), "Geometric constraints on potentially singular solutions for the 3-D Euler equations", submitted to Comm. P.D.E.
4. (with P. Constantin, C. Foias, and Igor Kukavica), "Dirichlet quotients and 2D periodic Navier-Stokes equations", submitted to Math Pure and Appl.

### Graduate Students Partially Supported

1. Richard McLaughlin, Ph. D. received June 1994
2. David Horntrop, Ph. D. received August 1995
3. Margaret Holen, Ph. D. received August 1995
4. J. Callet, graduate student, Ph. D. expected in June 1997

### Post Doctoral Fellow Partially Supported

1. Frank Elliott

### Honors and Awards

1. National Academy of Sciences Prize in Applied Mathematics and Numerical Analysis
2. Majda elected to National Academy of Sciences in April 1994
3. Majda gave Gibbs lecture of American Mathematical Society in January 1995

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